

**South Coast Air Quality Management District
Monitoring and Analysis**

Jefferson Elementary School Air Quality Study

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1.0 Executive Summary

The study undertaken at Jefferson Elementary School is a part of the South Coast Air Quality Management District's (SCAQMD) Children's Air Quality Agenda, and is in response to community concerns about possible children's exposure to toxic air contaminants. For this study an air pollution-monitoring platform was placed on the school grounds to collect various samples from August 5, 2000 to October 15, 2000 following the Multiple Air Toxics Exposure Study (MATES-II) protocol.¹ The results of this study were compared to the MATES II fixed sites using similar data analyses techniques as utilized in the MATES-II study. For appropriate comparisons, only the August through October MATES-II data were used.

The principal findings of the study are as follows:

- 1) Measurements at Jefferson Elementary School indicate levels of air toxics that are at or below Basin-wide levels measured during the MATES-II study. For many of the determinations the concentrations were below the minimum levels of detection, in the sub-part-per-billion (ppb) range.
- 2) Measurements of pollutants typically associated with mobile source emissions show the site is considerably below the Basin average during the MATES-II program. Mobile source emissions represent the greatest contributor to carcinogenic risk in the Basin (MATES-II Final Report, March 2000).
- 3) Measurements of pollutants typically associated with stationary source emissions show the site is impacted to an equivalent or less degree than the MATES-II Compton site and the Basin-wide average during the MATES-II program for the same season.
- 4) The above findings provide reasonable indications that levels of air toxics at the Jefferson Elementary School site are not unusually influenced by either mobile or stationary sources of emissions.

¹ Final Report MATES-II, March 2000, South Coast Air Quality Management District

2.0 Scope and Purpose

The purpose of this study is to address the concerns of the Compton community and the issue of possible exposure of the school children to toxic air contaminants at one of their schools. To provide a meaningful assessment, it is necessary to conduct sampling for toxic air contaminants, and then compare results to the MATES-II Study for perspective.

The SCAQMD conducted sampling at a single location on the school grounds of Jefferson Elementary School at 2508 E. 133rd Street, Compton from August 5, 2000 to October 15, 2000. Air samples were collected every six days for a total of thirteen sampling days.

Conclusions from the MATES-II Study indicate there are strong seasonal variations in toxic concentration levels and associated carcinogenic risks. This presents a significant limitation in comparing data taken year round to give annualized averages to relatively short studies such as the present study. To account for these seasonal influences, data from the MATES-II study used in this study were averaged only for the same time period of the year this study was performed. That is, the MATES-II averages and Compton site averages used for comparison were chosen from early August through mid October of 1998. The number of sampling days is the same for the MATES-II data as for the present study because MATES-II sampling was conducted on a one day in six schedule also.

Detailed analyses method descriptions follow in Section 6.0, Sampling and Analysis Methods. Complete reports of the raw data collected in this study can be found in Appendix A.

3.0 Topography and Site Description

The sampling site was located at Jefferson Elementary School on the 2500 block of E. 133rd Street, Compton (see Figure 1). The MATES-II Compton site was located at 700 N. Bullis Road, Compton, approximately 1 mile Southeast of the school. The school is centrally located between four freeways roughly encircling the school. The 710 Freeway is to the East, the 110 Freeway to the West, the 105 Freeway to the North, and the 91 Artesia Freeway is to the South. The area is typically flat with a mean elevation of 55 feet above sea level. The Alameda Corridor train tracks are within a mile of the campus, due East.

4.0 Climatology

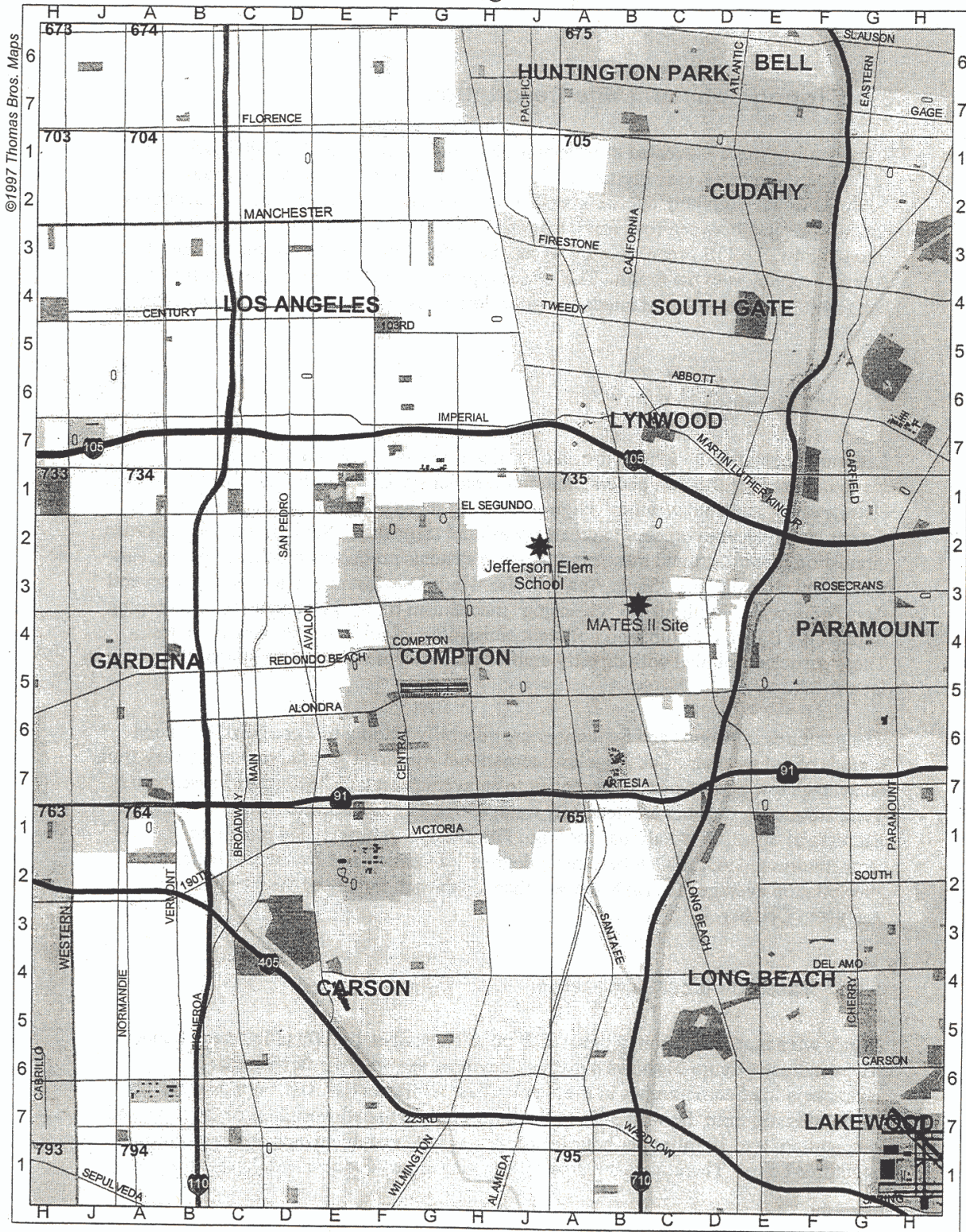
Late summer and early autumn are characterized by moderately hot temperatures and weakening sea breezes. In general, autumn weather systems are still too weak to produce cloudy, rainy, and cold weather. High-pressure systems that build up over the interior deserts counteract sea breezes to create occasional stagnation. Sometimes, the clockwise circulation of wind around these high pressure systems produces an intense, drying, east wind known locally as a “Santa Ana”. These winds may last only a few hours or several days Basin-wide. Without the “cleansing” mechanism of the Santa Ana winds sweeping through the Basin, moisture and pollutant emissions can react to form new particles. These particles, coupled with directly emitted particles, often lead to elevated PM₁₀ levels.

Temperatures in August and September are generally warm with occasional extended periods of hot weather. Los Angeles International Airport (LAX) temperatures vary from an average low of 64 degrees Fahrenheit to an average high of 76 degrees Fahrenheit. Temperatures in October are generally mild, which can be associated with the seasonal decrease of effective radiational cooling. The average minimum and maximum temperatures at LAX in October are 57 degrees Fahrenheit and 73 degrees Fahrenheit. Precipitation averages for LAX are less than a half inch for any of the months from August to October.

5.0 Meteorological Discussion

Winds were monitored from August 2, 2000 to November 1, 2000 at Jefferson School. The windrose (Figure 2) shows a distinct, daytime, sea breeze influence that is characteristic of communities in the South Coast Air Basin (SCAB). Winds were predominantly from the west 30% of the time, and west-southwest 24% of the time, and ranged from 0 to 10 miles per hour in speed. Lighter, variable winds occurred during nighttime hours. There were no strong Santa Ana winds documented during this period.

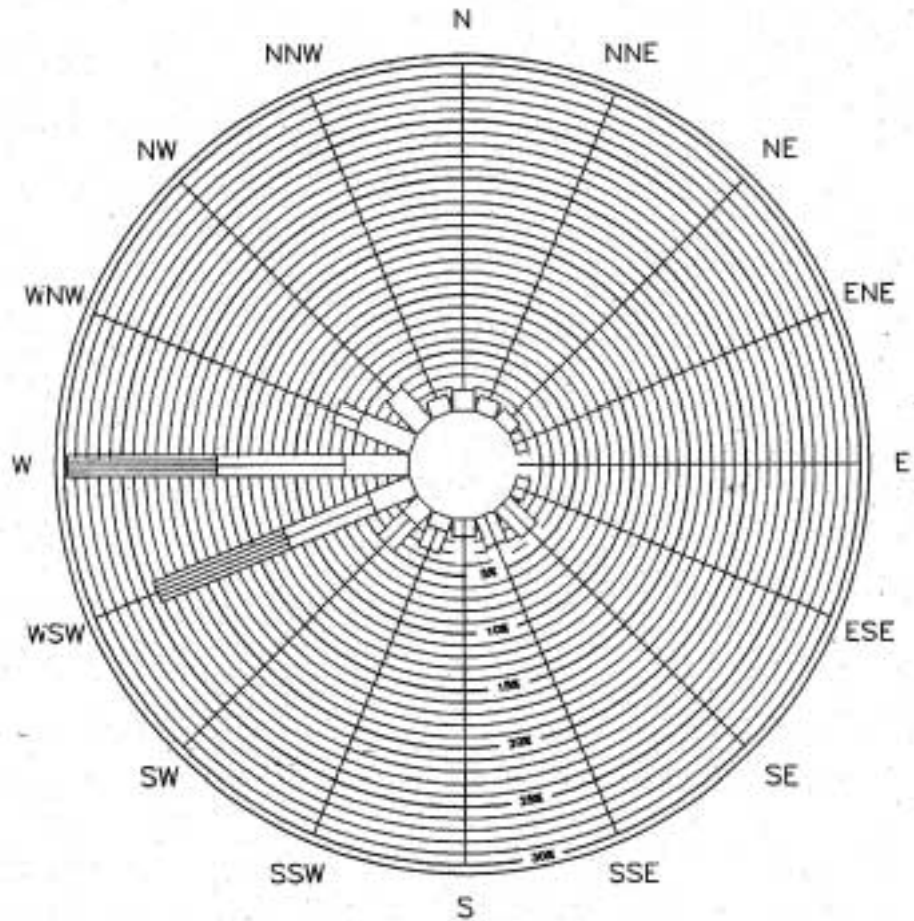
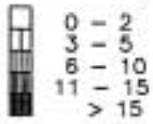
Figure 1



- * Jefferson Elem School: 2508 E 133rd St, Compton, 90222, 734 J2
- * MATES II Site: 700 N Bullis Rd, Compton, 90221, 735 B3

Figure 2

WIND SPEED (MPH)



JEFFERSON SCHOOL
8/2/00 - 11/01/00

6.0 Sampling and Analysis Methods and Data Evaluation

The following subsections describe the analytical methods used to measure specific toxic compounds. Found in the appendices is a listing of all compounds determined and their associated Minimum Detection Levels (MDLs). The study used the same sampling instruments and protocol used in the MATES-II study. Ambient air was sampled into Summa® polished canisters for volatile organic compounds; particulate matter was captured on filters for mass, elemental and organic carbon determination; filter cartridges were used for capturing carbonyl compounds (formaldehyde and acetaldehyde); and impregnated filters were used to capture chrome +6 (hexavalent chromium). One 24-hour integrated canister sample was taken each sampling day as well as three 8-hour canister samples the same day. The carbonyl and filter samples were 24-hour integrated samples taken every six days. This is also coincident with the 1-in-6 day network sampling schedule. This frequency matched the protocol used in the MATES-II project. This was done to allow a comparison to be made between the MATES-II data and this site. The canister samples were analyzed for volatile organic compounds (VOC's) by gas chromatography/mass spectrometry (GC/MS). The carbonyl samples were analyzed utilizing high-pressure liquid chromatography (HPLC). One set of filter samples was analyzed for mass and carbon content, a second set was analyzed for hexavalent chromium and a third set of filters was analyzed for elemental (i.e. metals) determination.

6.1 Volatile Organic Gases

Ambient air samples were pumped into Summa® polished canisters at a constant rate for either the 24-hour integrated sample or 8-hour samples to give approximately 10 psi pressure in the canister at the end of the sampling period. The filled canisters were returned within 48 hours to the AQMD laboratory for subsequent analysis. An aliquot (i.e. a sample) of gas is withdrawn from the canister and cryogenically (i.e., under very cold conditions) concentrated then injected into the gas chromatograph equipped with a mass spectrometer detector. The compounds of interest are separated, identified and quantified by comparison to standards made in the laboratory. The AQMD Laboratory Standard Operating Procedure (SOP) follows U.S. EPA codified methods as found in the "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", specifically Method TO-14A, "Determination of VOC's in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography."

6.2 Carbonyl Compounds

Carbonyl compounds are the class of chemical compounds encompassing aldehydes and ketones that contain a carbon atom double bonded to an oxygen atom. Formaldehyde is the simplest molecule of this class and is considered a carcinogen and a precursor to smog formation. To measure carbonyls, ambient air is pumped through cartridges impregnated with a fixing agent to capture low molecular weight aldehydes and ketones. For the 24-hour samples, approximately 1 cubic meter of air is drawn through the cartridge to capture the carbonyl compounds. The samples are kept refrigerated after sampling until they are extracted for analysis by high-pressure liquid chromatography. The compounds of interest are identified and quantified by comparison to laboratory made standards. The SOP for this analysis is codified in the EPA manual mentioned in 6.1 Volatile Organic Compounds, and the specific method is “TO-11- Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed By High Performance Liquid Chromatography.”

6.3 Elemental Carbon

Elemental carbon (EC) is an indicator of diesel particulate, which has been designated as a toxic air contaminant by the California Air Resources Board. To determine the concentration of EC, ambient air is pulled through a quartz fiber filter via a vacuum for 24 hours at a prescribed flow rate with a size selective inlet high volume sampler (SSI-Hi-Vol). The particles captured are less than 10 microns in size (PM10) (e.g., less than 1/7th the thickness of a human hair.) These particles are of concern because they are very small and can bypass human body defense mechanisms and lodge in the lungs. A fraction of the sampled filter is put into a carbon analyzer and the mass of elemental (e.g., soot) and organic carbon contained on the filter is determined. The mass of carbon is divided by the volume of air sampled to give the concentration of carbon particles in the air. The carbon analyzer uses the thermal/optical method where the filter is heated in steps to drive off the carbon in its various fractions with the carbon converted to methane by a catalyst and detected by a flame ionization detector. A laser is used to determine reflectance of the filter for differentiation between organic and elemental carbon. The method is referred to as the Thermal/Optical Reflectance Method (TOR).

6.3 Chrome VI (Hexavalent Chromium)

Hexavalent chromium, a potent toxin, is produced primarily from certain metal operations, such as chrome plating. Levels of hexavalent chromium in the air have been reduced substantially over the past decade due to regulatory controls on relevant industries.

For analysis, ambient air is drawn via vacuum through a cellulose fiber filter at a prescribed rate for 24-hours. The filter is treated with sodium bicarbonate to prevent conversion of chrome-VI in the air to chrome-III, which is not considered an acute hazard. The filter is brought to the laboratory quickly after sampling to be extracted by sonication. The extract is injected into an ion chromatograph that is especially optimized for chrome-VI analysis. The samples are compared to laboratory-made standards for identification and quantification.

6.5 Elemental Analysis

Elemental analysis (i.e. measurement of individual chemical elements such as aluminum, iron, magnesium etc.) can be used to identify the sources contributing to particulate matter. It is used in this study to look for the possibility of a toxic hot spot where one element would stand out from the typical background indicating the presence of a source.

For sampling, ambient air is drawn through a 37 mm Teflon filter loaded in a Xontech 920 sampler. Typically, 24-hour sampling at 10 liters per minute provides sufficient sample mass on the filter for successful analysis. The sampler must collect a homogeneous sample across the face of the Teflon filter.

For analysis, an Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer is used to analyze 35 elements in the filter sample. There is no need for sample preparation other than bringing the filters to room temperature. Each filter is loaded onto a sample wheel and brought to a vacuum and scanned under five different instrument conditions. Each condition of secondary target and energy of the X-rays is optimized for certain groups of elements. After spectral acquisition, an identification and deconvolution process extracts the net contributions of each of the 35 elements.

7.0 Results and Discussion

The laboratory analytical results are summarized in the following Tables.

A summary of the VOCs quantified in this study is shown in Table 1. The average concentration for each compound and the maximum and minimum value found during the course of the study are listed. In addition, the number of non-detects (NDs) (e.g. concentrations so low that they cannot be detected by the instrument) and the number of data points for each compound are listed. In the Appendix under Toxic Organics Report is the raw data listing of the concentrations found for 20 compounds that were quantified for each canister sample taken. Many of the concentrations found are at or below the minimum detection level (MDL).

Table 1
Summary of VOCs Quantified

Compound	Average (ppbv)	Maximum (ppbv)	Minimum (ppbv)	MDL ¹ (ppbv)	N ²	# of NDs ³
Chloromethane	0.37	0.5	0.3	0.1	13	0
Chloroethene	0.1	0.1	0.1	0.2	13	13
1,3-Butadiene	0.065	0.2	0.05	0.1	13	6
1,1-Dichloroethene	0.05	0.05	0.05	0.1	13	13
Methylene Chloride	0.15	0.4	0.05	0.1	13	5
1,1-Dichloroethane	0.05	0.05	0.05	0.1	13	13
Chloroform	0.05	0.05	0.05	0.1	13	13
1,2-Dichloroethane	0.05	0.05	0.05	0.1	13	13
Benzene	0.188	0.4	0.05	0.1	13	2
Carbon Tetrachloride	0.1	0.1	0.1	0.2	13	13
Trichloroethene	0.05	0.05	0.05	0.1	13	13
Toluene	0.56	1.2	0.2	0.1	13	0
1,2-Dibromoethane	0.05	0.05	0.05	0.1	13	13
Perchloroethylene	0.057	0.1	0.05	0.1	13	11
Ethylbenzene	0.06	0.1	0.05	0.1	13	10
(m+p)-Xylenes	0.246	0.7	0.05	0.1	13	2
Styrene	0.05	0.05	0.05	0.1	13	13
o-Xylene	0.08	0.2	0.05	0.1	13	9
p-dichlorobenzene	0.05	0.05	0.05	0.1	13	13
o-Dichlorobenzene	0.05	0.05	0.05	0.1	13	13

¹MDL = Minimum Detection Level

²N = Number of samples taken

³NDs = Non-detects (below detection of the instrument) NDs were replaced with ½ the MDL for calculation of the minimum, maximum and average.

Shown in Table 2 is the maximum and average value found at Jefferson School and at the Compton MATES-II site during the same season. This comparison indicates that at Jefferson School the maximum determined value for all compounds did not exceed the values determined at the Compton site during the MATES-II program. Likewise, the average values determined for the Jefferson site were considerably lower than the average values at the MATES-II Compton site.

Table 2
Comparison of VOC Maximum and Average Concentrations

	Jefferson School		MATES-II Compton	
	Maximum	Average	Maximum	Average
	(ppbv)	(ppbv)	(ppbv)	(ppbv)
Chloromethane	0.5	0.37	1.2	0.71
Chloroethene(VC)	0.1	0.10	0.1	0.10
1,3-Butadiene	0.2	0.065	1.3	0.320
1,1-Dichloroethene (VDC)	0.05	0.05	0.05	0.05
Mehtylene Chloride	0.4	0.15	1.5	0.74
1,1-Dichloroethane	0.05	0.05	0.05	0.05
Chloroform	0.05	0.05	0.10	0.05
1,2-dichloroethane(EDC)	0.05	0.05	0.05	0.05
Benzene	0.4	0.188	3.1	1.031
Carbon Tetrachloride	0.1	0.10	0.11	0.10
Trichloroethene	0.05	0.05	0.26	0.07
Toluene	1.2	0.56	9.6	3.38
1,2-Dibromoethane	0.05	0.05	0.05	0.05
Perchloroethylene	0.1	0.057	1.2	0.357
Ethylbenzene	0.1	0.06	1.4	0.49
(m+p)-Xylenes	0.7	0.246	5.5	1.567
Styrene	0.05	0.05	0.6	0.29
o-Xylene	0.2	0.08	1.9	0.53
p-Dichlorobenzene	0.05	0.05	0.5	0.31
o-Dichlorobenzene	0.05	0.05	0.2	0.07

A summary of the elemental compounds determined at Jefferson Elementary School is shown in Table 3. The table is a summary of the maxima and average values found for each element determined for Jefferson School and the MATES-II Compton site during the same season. The elemental analysis is performed to scan for abnormalities in the particulates fraction as compared to an average basin site. Those elements that are significantly higher than found elsewhere during the same season would be suggestive of a source (e.g mobile or stationary) influencing the monitoring site. Such is not the case in this study. A rather large range of elemental concentrations can occur due to the nature of the soils in the surrounding area and the immediate micro-meteorology and topography.

Table 3
Summary of Elements Quantified

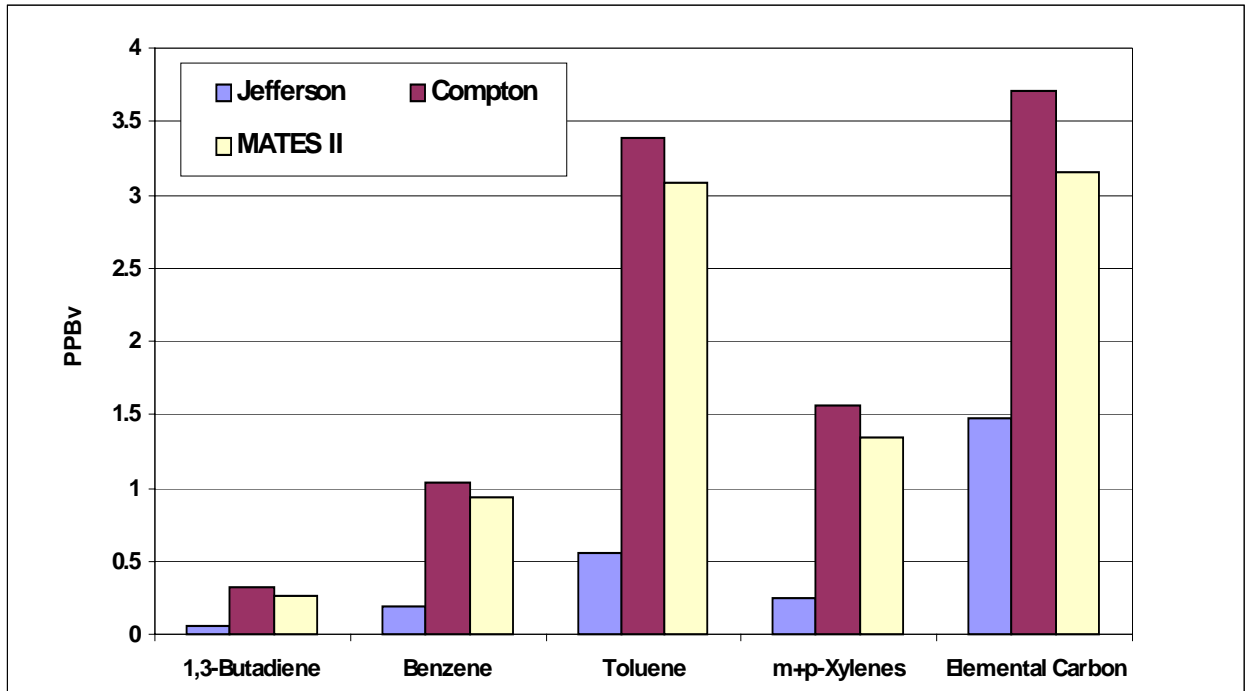
		Jefferson		MATES-II	
Element	Units	Maximum	Average	Maximum	Average
Aluminum	($\mu\text{g}/\text{m}^3$)	6.023	3.202	2.005	1.273
Silicon	($\mu\text{g}/\text{m}^3$)	6.344	2.628	6.533	4.020
Phosphorous	($\mu\text{g}/\text{m}^3$)	0.327	0.229	0.079	0.041
Sulfur	($\mu\text{g}/\text{m}^3$)	3.467	2.196	3.911	1.926
Chlorine	($\mu\text{g}/\text{m}^3$)	2.496	1.180	4.896	1.374
Potassium	($\mu\text{g}/\text{m}^3$)	0.787	0.576	1.810	0.881
Calcium	($\mu\text{g}/\text{m}^3$)	4.268	1.876	4.269	1.624
Titanium	($\mu\text{g}/\text{m}^3$)	0.275	0.173	0.393	0.152
Vanadium	($\mu\text{g}/\text{m}^3$)	0.050	0.034	0.056	0.019
Chromium	($\mu\text{g}/\text{m}^3$)	0.005	0.003	0.009	0.004
Manganese	($\mu\text{g}/\text{m}^3$)	0.053	0.033	0.068	0.029
Iron	($\mu\text{g}/\text{m}^3$)	2.567	1.611	3.906	1.722
Nickel	($\mu\text{g}/\text{m}^3$)	0.019	0.013	0.030	0.010
Copper	($\mu\text{g}/\text{m}^3$)	0.054	0.039	0.043	0.017
Zinc	($\mu\text{g}/\text{m}^3$)	0.133	0.094	0.236	0.091
Arsenic	($\mu\text{g}/\text{m}^3$)	0.011	0.005	0.002	0.002
Lead	($\mu\text{g}/\text{m}^3$)	0.033	0.019	0.048	0.017

7.1 Mobile Source Air Toxics

Figure 3 charts the averages of the key toxic air contaminants typically associated with mobile source emissions. The compounds are 1,3-butadiene, benzene, toluene, m+p-xylenes, and elemental carbon (diesel emissions surrogate). The bars represent the average concentrations for Jefferson Elementary School, the MATES-II Compton site and the MATES-II basin-wide values for each compound. It can be seen from Figure 3 that the Jefferson site levels are well below the MATES-II levels for the compounds indicating mobile source contributions.

Figure 3

Key Toxic Air Contaminants Typically Associated With Mobile Sources



7.1.1 VOC Comparisons

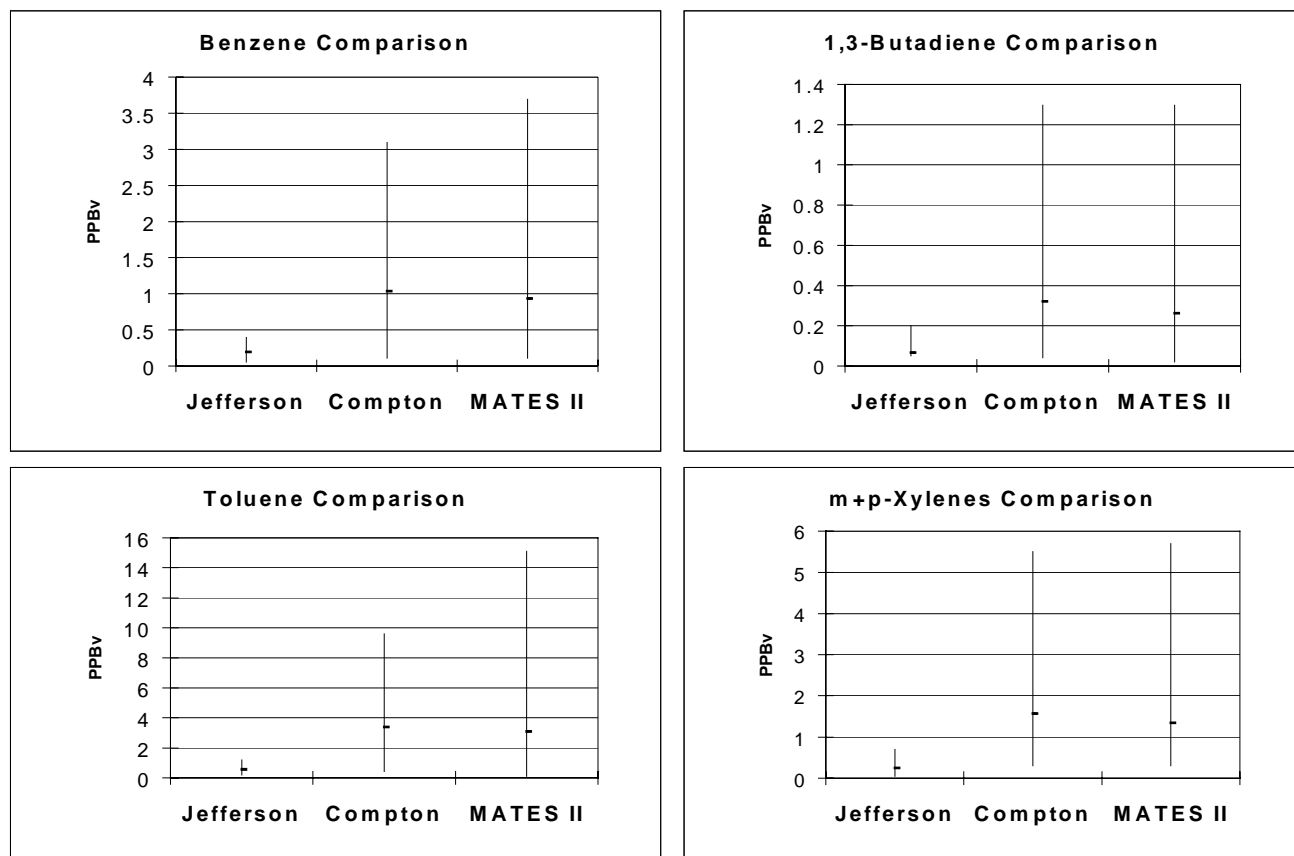
Four compounds are examined using the charts as shown in Figure 4 to compare the present findings to the Compton site (the nearest MATES-II site) and the MATES-II basin-wide data for the time period of early August to mid October. Thirteen sample days in this study were compared to a comparable thirteen sample days from the MATES-II study. The four compounds charted here were chosen because of their importance to identifying mobile source emissions. Benzene and 1,3-butadiene contribute an important share of the overall risk to the residents of the Basin. Toluene and xylenes are also key indicators of mobile source contributions to the organic gas

present in ambient air. The charts in Figure 4 show the average concentration and minimum and maximum values for; 1) Jefferson School, present study, 2) Compton (MATES-II data); and 3) across the South Coast Air Basin average (denoted MATES-II in the chart). For purposes of this analysis, non-detects have been replaced with $\frac{1}{2}$ the MDL in keeping with the MATES-II convention for handling non-detects in a data set. This method of handling non-detects is considered a conservative estimate of risk when very little data above the MDL is available. The charts give an indication of the variation of these organic gases found over a period of weeks and varying weather conditions.

Figure 4 is an amplification of the data shown in Figure 3. The variability, as measured by the size of the vertical lines, indicates that the Jefferson site had consistently low levels over the course of the study. 1,3-butadiene, benzene, toluene and xylene are all low in comparison to MATES-II data for the Basin and the city of Compton. Mobile source emissions represent the greatest contributor to carcinogenic risk in the Basin (MATES-II Final Report, March 2000).

Figure 4

VOC Comparison



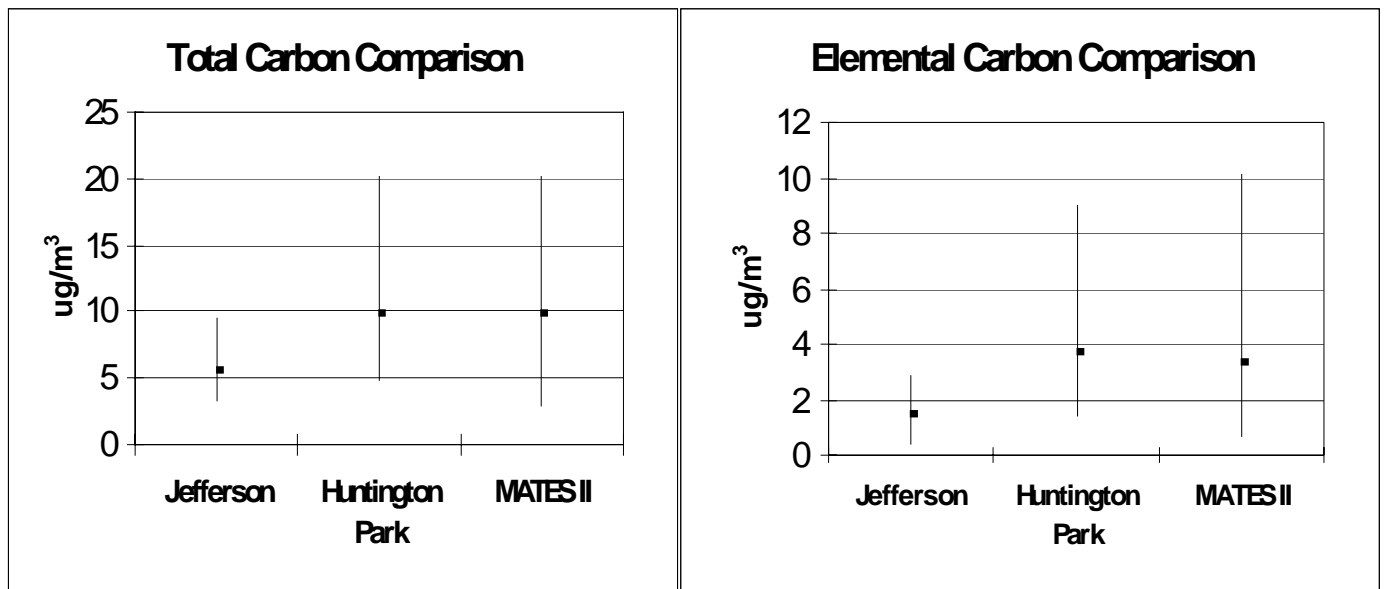
- = Average value
- | = Minimum and Maximum values

7.1.2 Carbon Comparisons

There is currently no analytical technique for direct measurement of diesel particulates, the major contributor to Basin-wide carcinogenic risk. Based on research results as reported by the California Air Resources Board (CARB), diesel particulates can be estimated by measuring elemental carbon. In essence, elemental carbon becomes a surrogate for diesel particulates. Although this technique is likely to have uncertainties, comparisons using elemental carbon can be used to draw inferences as to the impact of diesel traffic.

Figure 5 consists of two charts showing the comparison between elemental carbon and total carbon at Jefferson to MATES-II basin-wide averages and the nearest MATES-II site at Huntington Park. (Carbon analysis was not performed at the Compton MATES-II site.) The elemental carbon is a subset of the total carbon which consists of elemental and organic carbon. The ratio of elemental to total carbon is consistent with MATES-II findings. The charts indicate that elemental carbon at the Jefferson School site is not excessive and correlates with the other analyses performed in this study that indicate mobile sources are not unduly impacting the Jefferson site.

Figure 5

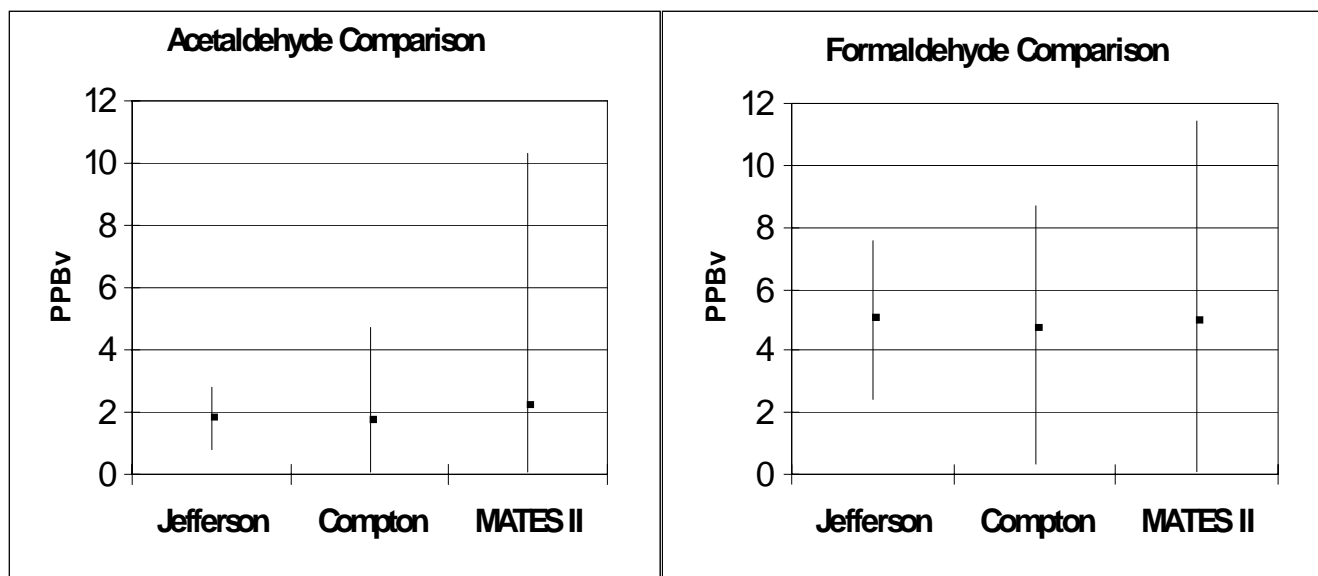


- = Average value
- | = Minimum and Maximum values

7.1.3 Carbonyl Comparisons

Figure 6 compares the levels of formaldehyde and acetaldehyde at Jefferson to the MATES-II basin wide average and the Compton average for the same season. These air toxic chemical compounds are also indicative of mobile source emissions. The levels found in this study were comparable to those found in the MATES-II study. Since these chemicals can be formed in the atmosphere via reactions of precursor mobile source emissions, a more regionally consistent level of these pollutants would be expected, as compared to directly emitted VOCs.

Figure 6



- = Average value
- | = Minimum and Maximum values

7.2 Stationary Source Air Toxics

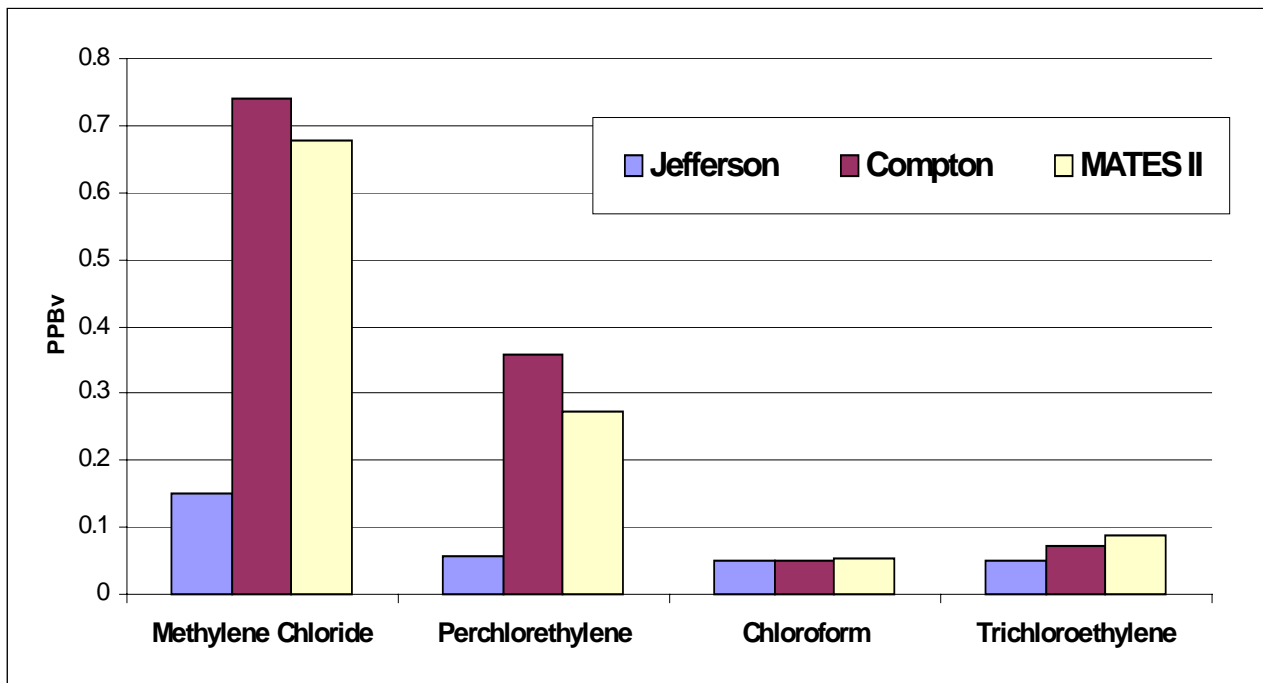
7.2.1 VOC Comparisons

Toxic VOC compounds from stationary sources are typically halogenated compounds used for degreasing, coating or solvents in the manufacture of goods or services. Perchloroethylene is used in the dry-cleaning of clothes, chloroform is used in coating operations, and methylene chloride and trichloroethylene are used in degreasing operations.

The toxic gaseous compounds associated with stationary sources do not show as much seasonal variation as the mobile source emissions as found in the MATES-II study. As shown in Figure 7 the levels observed at the Jefferson School site for these four key compounds typically associated with stationary sources are also below the Basin average and the Compton MATES-II site.

Figure 7

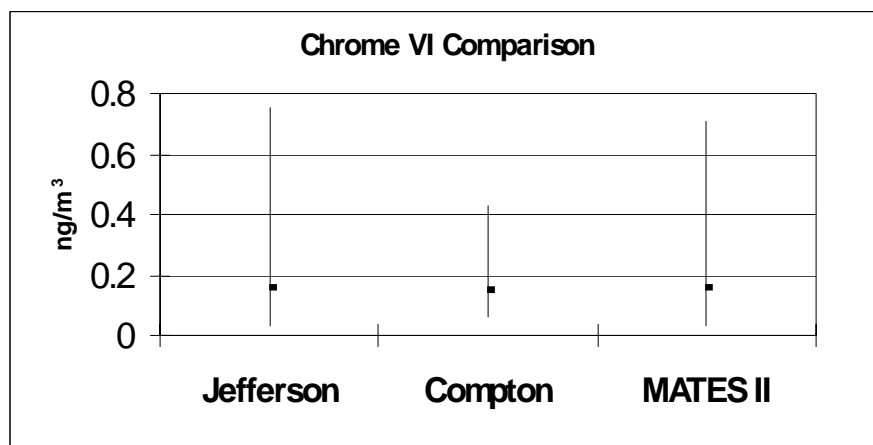
Key Toxic Air Contaminants Typically Associated With Stationary Sources



7.2.2 Chrome VI (Hexavalent Chromium) Comparisons

Hexavalent chromium is released primarily from stationary sources such as chrome platers. At the Jefferson School site, 6 of 13 samples taken were below the detection limit of 0.06 nanograms per cubic meter. By assuming the non-detects lay halfway between 0 and 0.06, the data from this study can be compared to the MATES-II data across the Basin. Figure 8 indicates that the average levels of chrome VI at Jefferson School are consistent with levels found during the MATES-II program, though the variability of the data tended to be greater than the Compton MATES-II site.

Figure 8



• = Average value

| = Minimum and Maximum values

7 Conclusion

From the analysis of the samples collected, the following are the principal findings of the study:

- 1) Measurements at Jefferson Elementary School indicate levels of air toxics that are at or below Basin-wide levels measured during the MATES-II study. For many of the determinations the concentrations were below the minimum levels of detection, in the sub-part-per-billion (ppb) range.
- 2) Measurements of pollutants typically associated with mobile source emissions show the site is considerably below the Basin average during the MATES-II program. Mobile source emissions represent the greatest contributor to carcinogenic risk in the Basin (MATES-II Final Report, March 2000).
- 3) Measurements of pollutants typically associated with stationary source emissions show the site is impacted to an equivalent or less degree than the MATES-II Compton site and the Basin-wide average during the MATES-II program for the same season.
- 4) The above findings provide reasonable indications that levels of air toxics at the Jefferson Elementary School site are not unusually influenced by either mobile or stationary sources of emissions.